Topic 9
Symbol Manipulation
Generating English Sentences

Section 2.3.2
This is an additional example to symbolic differentiation in book.

October 2008

Example of Symbol Manipulation

- One of the corner stones of Lisp/Scheme is its ability to easily manipulate symbols.
- Because of this it has been heavily used in Artificial Intelligence.
- As an example, we will write a program to manipulate English Sentences.

What makes an English Sentence?

Consider very simple sentences (Context Free Grammar):

S → NP VP
NP → N | Adjective NP
N → dog | cat | professor | student | rat
Adjective → red | slow | dead
VP → V | V Adverb
V → ran | ate | slept | drank
Adverb → quickly | happily | well

How might we generate using a Context Free Grammar?

- Start with S
- Find a rule whose left hand side matches S
- Replace S with the right hand side of the rule
- Continue

Example Generation

S → NP VP
NP → N | Adjective NP
N → dog | cat | professor | student | rat
Adjective → red | slow | dead
VP → V | V Adverb
V → ran | ate | slept | drank
Adverb → quickly | happily | well

- S
- NP VP
- N VP
- Professor VP
- V
- Professor ate

Slight Modification

S → the NP VP
NP → N | Adjective NP
N → dog | cat | professor | student | rat
Adjective → red | slow | dead
VP → V | V Adverb
V → ran | ate | slept | drank
Adverb → quickly | happily | well

- S
- The NP VP
- The Adjective NP VP
- The slow NP VP
- The slow Adjective NP VP
- The slow red NP VP
- The slow red N VP
- The slow red student VP
- The slow red student V Adverb
- The slow red student slept Adverb
- The slow red student slept happily

Implementation

- Phrases will be represented as lists of words

- Example: (ate) and (ate quickly) are both verb phrases.

- Example: (professor) and (slow red professor) are both noun phrases.

Sentence Procedure

- Creates a list of words that are "in the language" of the context free grammar defined earlier.
- How?
- Append them all together
- SHOW CODE

Implications

- Means that (noun-phrase) and (verb-phrase) are procedures that return lists of words
- We saw in sentence, that it pretty much followed the right hand side of the rule

Problem:
- We have two right hand sides for each of noun-phrase and verb phrase
- We want to randomly pick between them

Scheme allows random selection

- (random 3)
- Will select randomly between 0 1 2….